Pipeline Group Factual Report

ATTACHMENT 34

Welding Specification and Procedure

Carmichael, Mississippi
DCA 08 MP 001

WELDING

PIPE: This specification shall apply to the field welding of pipe, defined in the JOB DESCRIPTION, manufactured in conformance to American Petroleum Institute Standards 5L, Line Pipe and 5LX, High Test Line Pipe, and it shall also apply to field welding of pipe not manufactured in conformance to those specifications.

METHODS: Welds shall be made in accordance with the welding procedures or procedures specified by Company marked EXHIBIT "E." All requirements affecting the quality of the completed welds shall apply equally to roll welding and position welding. (Note: Until this specification is expanded to include submerged arc welding processes applicable to the multiple jointing of pipe, the quality of such submerged arc welds shall be at least equal to the minimum standards of acceptability herein established for welds made by manual methods.)

PIPE DEFECTS: Should laminations, split ends, or other defects in the pipe be discovered, the joint of pipe containing such defects shall be cropped, repaired, or removed from the line as directed by the Company representative.

WELDING EQUIPMENT AND SUPPLIES: Contractor shall furnish all welding equipment and supplies. All electrodes and equipment shall be subject to the approval of Company and shall be kept in good operating condition. Any equipment or supplies not meeting the approval of Company or not capable of producing satisfactory welds shall be removed from the job. Contractor shall protect welding electrode from moisture and deterioration.

SPACING: The space between abutting pipe ends shall be such as to insure complete penetration without burn-through. For pipe ends having mill bevels the spacing shall be approximately 1/16 inch. The spacing should be decreased proportionally, for pipe ends having smaller width land.

ALIGNMENT:

(1) Offset. The alignment of the abutting pipe ends shall be made to minimize the offset between pipe surfaces. For pipe of the same nominal wall thickness, the offset shall not exceed 1/16 inch. Any greater offset shall be equally distributed around the circumference of the pipe. Hammering of pipe to obtain proper line-up shall be held to a minimum.

(2) Internal Line-Up Clamp. An internal line-up clamp shall be used, whenever practical, for all sizes of pipe 10 3/4-inch O.D. and larger. Internal line-up clamps may be removed after the root bead is 50 per cent completed, provided the completed part of the root bead is in segments of approximately equal lengths, and the segments are equally spaced about the circumference of the pipe. However, if conditions make it difficult to prevent movement of the pipe, or if the weld would be unduly stressed, the root bead shall be completed before releasing clamp tension.

(3) External Line-Up Clamp. An external line-up clamp shall be used where it is impractical or impossible to use an internal line-up clamp. Root-bead segments used in connection with external clamps shall be uniformly spaced around the circumference of the pipe and shall have an accumulative length of not less than 50 per cent of the pipe circumference before the clamp is removed.

WELDING PROCEDURE: All position welds shall be made with the pipe resting on skids placed over or at the side of the ditch. All beads shall be made using the specified type and size electrode. No two beads shall be started at the same location. The number of beads required shall be governed by the wall thickness of the pipe. Each bead shall be cleaned to the satisfaction of the Company Inspector before any succeeding bead is applied.

(1) Root Bead. The entire root bead shall be made with the pipe in a stationary position. It is mandatory that at least 2 weldors be used, operating simultaneously and in opposite quarters, when welding root beads. Movement of the pipe during the welding of the root bead shall be held to an absolute minimum.

(2) Filler and Finish Beads. After the root bead has been completed, it is permissible and may be made mandatory by the Company, to add second bead immediately, after which the specified number of beads may be made by finish weldors, each succeeding bead having a thickness of approximately 1/8 inch. The number of filler beads shall be such that the completed weld will have a reinforcement of not less than 1/32 inch and not more than 1/16 inch above the pipe surface. The width of the cover bead shall be approximately 1/8 inch greater than the width of the original groove. Weld metal shall be thoroughly fused to previously deposited metal and to the parent metal of the pipe. The completed weld shall be thoroughly brushed and cleaned.

WELDING DURING INCLEMENT WEATHER: No welding shall be performed when weather conditions impair the quality of the weld.

PREPARATION OF PIPE ENDS: All pipe and bevels shall be cleaned by a method approved by the Company. All bevels not made by pipe mills shall be made by an approved type beveling machine in accordance with welding procedure EXHIBIT "E."

WELDS: The welding machine shall be adjusted so as to maintain the proper current and voltage output for the size and type of electrode used. The welds shall be capable of developing 100 per cent of the tensile strength of the pipe wall. Additional beads or portions thereof shall be added to reinforce the weld, when this procedure is required by the Company Inspector. All slag and scale shall be removed from each bead immediately after completion.

REPAIR OR REMOVAL OF DEFECTS:

(1) Company Authorization of Repairs. The Company Inspector may authorize repairs of defects in the root and filler beads, but any weld that shows evidence of repair work having been done without such authorization shall be rejected.

Minor cracks on the surface of the weld or in filler beads may be repaired when authorized by the Company, but any crack penetrating the root bead or the second bead shall be cause for complete rejection and removal of the weld. Minor cracks shall be defined as cracks visible in the surface of a bead and not over 2 inches in length.

Repairs may be made to pin holes and undercuts in the final bead without authorization, but must meet with the approval of the Company.

(2) Removal and Repair of Defects. Before repairs are made, injurious defects shall be entirely removed by chipping, grinding, or flame gouging to sound

metal. All slag and scale shall be removed by wire brushing. Preheating of such an area may be required by the Company.

TESTING WELDORS: The Company shall require each weldor employed by the Contractor to pass the Company's standard welding test as outlined below. At its option the Company may examine the qualification weld radiographically.

(1) Sampling of Test Welds. From the completed test weld the number of coupons cut will depend upon the size of the pipe and requirements of the Company. Test coupons shall be cut from the completed weld as follows:

Pipe Size: Outside Diameter (Inches)	Total Number of Coupons	Number of Tests			
		Tensile	Nick Break	Root Bend	Face Bend
More than 12-3/4	12	4	4	2	2

Coupons shall be taken from or adjacent to the top, sides, and bottom of the weld, and shall be spaced approximately equidistant around the pipe.

(2) Tensile Tests.

(a) Preparation. Tensile-test specimens shall be approximately 1 inch wide; the weld reinforcements, both at the face and at the root of the weld, shall not be removed. Coupons may be flame cut and no additional machining or preparation will be necessary, provided the sides are parallel and free from notches or unevenness which may adversely affect the test results. Coupons shall be allowed to air cool to ambient temperature before testing.

(b) Results. If two or more of the coupons tested break in the weld or at the junction of the weld and the parent metal, and also fail to develop the minimum specified tensile strength of the parent metal, the weldor shall be disqualified.

(3) Nick-Break Tests.

(a) Preparation. Nick-break test coupons shall be flame cut, and no other preparation will be necessary. The coupons shall be hacksaw notched from both edges of the coupons at the center of the weld to cause failure in the weld metal, and shall be broken by: a) pulling in a suitable testing machine; b) supporting the ends and striking the center of the coupon with a heavy hammer; or c) by supporting one end of the coupon in a vise and striking the other end with sharp hammer blows. The exposed area of the fracture shall have a minimum width of 1 inch.

(b) Results. The nick-break test shall show complete penetration and fusion throughout the entire thickness of the weld coupon. If, in the opinion of the Company representative, lack of penetration occurring in one of the test coupons is not representative of the weld, the coupon may be replaced by another coupon cut adjacent to the coupon that was rejected. The exposed surface shall show no more than 6 gas pockets per square inch with the greatest dimension not to exceed 1/16 inch. Slag inclusions shall be not

greater than 1/32 inch in depth and 1/8 inch in width, and shall be separated by at least 1/2 inch of sound weld metal. The weldor shall be disqualified if any one coupon shows defect exceeding these limitations.

(4) Bend Tests.

(a) Preparation. The coupons shall be approximately 1 inch wide and shall be flame cut. Both the cover and root bead reinforcement shall be removed flush with the base pipe metal. Final removal of excess metal shall leave the surface free of deep scratches, and any remaining scratches shall be transverse to the weld. Sharp edges shall be reduced to a smooth radius. One-half the number of coupons shall be subjected to face-bend tests, and the other half of the number of coupons shall be subjected to root-bend tests. Coupons shall be air cooled to ambient temperature before testing.

(b) Method. All bend-test coupons shall be tested in a guided test bend jig. Each coupon shall be placed on the female member of the jig with the weld at mid-span. Face bend coupon shall be placed with the face of the weld directed toward the gap; root bend coupons shall be placed with the root of the weld directed toward the gap. The male member of the jig shall be forced into the gap until the curvature of the coupon is approximately 180 degrees.

(c) Results. The bend test shall be considered acceptable if:

No crack or other defect exceeding 1/8 inch in any direction is present in the weld metal or between the weld and the pipe material after bending (Cracks which originate along the edges of the specimen during testing and that are less than 1/4 inch measured in any direction shall not be considered.), or

The coupon cracks or fractures during bending and the exposed surface shows: a) complete penetration and fusion throughout the entire thickness of the weld coupon; b) no more than 6 gas pockets per square inch with the greatest dimension not to exceed 1/16 inch; and c) no slag inclusions greater than 1/32 inch in depth or 1/8 inch in width and separated by at least 1/2 inch of sound metal. (If necessary, the specimen shall be broken apart to permit examination of the fracture.)

Welds in high strength pipe, API Std. 5LX, which may not bend the full 180 degrees shall be qualified under the clause immediately above.

Should one of the weldor's bend test coupons fail to meet these requirements and, in the opinion of the Company representative, lack of penetration occurring is not representative of the weld, the test coupon may be replaced by an alternative coupon cut adjacent to the one that failed. The weldor shall be disqualified if the alternative coupon also shows defects exceeding the specified limits.

(5) Qualification. The weldor may be recognized as fully qualified only if the test weld coupons are acceptable as to tensile strength and soundness. The weld must be free of cracks, lack of penetration, burn-through, and other obvious defects, and it must present a neat workmen-like appearance. Undercutting adjacent to the final bead on the outside of the pipe shall not exceed 1/32 inch in depth.

(6) Retest. If, in the mutual opinion of the Company and Contractor representatives, failure of a weldor to pass the test was because of unavoidable conditions or conditions beyond his control, such a weldor may be given a second opportunity to qualify. No further retest shall be permitted.

Contractor shall furnish all equipment and supplies required for this test, with the exception of pipe nipples which Company shall furnish.

After Company Inspector has determined that the weldor meets Company's requirements, the Contractor shall issue an identifying symbol to that weldor and each weld made by that weldor shall be so identified. Company Inspector will record the symbol and the name of the weldor. If the weldor should leave the job, his identifying symbol shall be voided and not duplicated.

TEST WELDS: Company shall reserve the privilege of cutting any weld from the pipe line and that weld may then be tested in the manner stated above. If the weld is tested and conforms to all Company requirements, the Company will reimburse the Contractor for the cost of replacing the weld, except that the Company shall be permitted to cut one (1) test weld made by each weldor from the line at no cost to the Company. If the test weld shall fail in any of the standard Company tests, the weldor may not be permitted to continue welding on the pipe line. If two or more weldors participated in making the weld which failed, the Contractor and Company Inspector shall determine which weldor or weldors were responsible for the defective work.

All welds which fail shall be replaced at no expense to the Company. Company shall whenever possible, cut test welds from the pipe line in such a manner or at such a time so as to result in a minimum replacement cost. If it is not possible to pull the pipe back into position after a weld has been removed, a nipple with a minimum length of forty-eight (48) inches shall be set in and two (2) welds shall be required to close the line. Company reserves the right to cut any of these replacement welds from the pipe if there is evidence of defective workmanship.

REIMBURSEMENT FOR EXTRA WELDS: A record of results of each weld test shall be made jointly by the Company Inspector and the Contractor's representative. When a weld that has met Company's specifications has been cut out, except for the one (1) above described weld per weldor, the Contractor shall be reimbursed for the weld in accordance with the price quoted on his bid sheet. The record made jointly by the Company and Contractor shall indicate the location of the weld by stake number, the weldor's symbol, and the results of the test. This record shall be signed by representatives of both the Company and Contractor and must be made on the day the test is performed. No reimbursement will be made for any weld not covered by a Memorandum of Work Performed.

PREHEATING AND POSTHEATING: The Company shall specify in the Welding Procedure EXHIBIT "E" what preheating and postheating practices shall be used on the pipe

ends when chemical properties or atmospheric temperatures affect the weldability of the pipe.

RADIOGRAPHIC INSPECTION:

Standards of Acceptability. Inspection that discloses welds failing to conform with the following standards of acceptability shall be deemed defective. Defective welds shall be repaired or cut out and replaced at Contractor's expense.

(1) Limitation of Discontinuities.

(a) Lack of Penetration and Lack of Fusion. Any individual lack of penetration or fusion shall not exceed 1 inch in length. In any 12-inch length of weld, the total length of lack of penetration or fusion in any 2 succeeding 12-inch lengths shall not exceed 2 inches and individual defects shall be separated by at least 6 inches of sound weld metal.

(b) Burn-Through Areas. Any individual burn-through area shall not exceed 3/4 inch in length. In any 12-inch length of weld, the total length of burn-through area shall not exceed 1-1/2 inches. The total length of burn-through area in any 2 succeeding 12-inch lengths shall not exceed 3 inches, and individual defects shall be separated by at least 6 inches of sound weld metal.

(c) Slag Inclusions.

(i) Elongated Slag Inclusions (Wagon Tracks). Any elongated slag inclusion shall not exceed 2 inches in length or 1/16 inch in width. In any 12-inch length of weld, the total length of elongated slag inclusions shall not exceed 2 inches. The total length of elongated slag inclusions in any 2 succeeding 12-inch lengths shall not exceed 4 inches and individual defects shall be separated by at least 6 inches of sound weld metal. Parallel slag lines shall be considered as individual defects if their width is greater than 1/32 inch.

(ii) Isolated Slag Inclusions. The maximum width of any isolated slag inclusion shall not exceed 1/8 inch. In any 12-inch length of weld, the total length of isolated slag inclusions shall not exceed 1 inch, nor shall there be more than 4 isolated slag inclusions of the maximum width of 1/8 inch in this length. Any 2 such inclusions shall be separated by 2 inches of sound weld metal. In any 24-inch length of weld, the total length of isolated slag inclusions shall not exceed 2 inches.

(d) Gas Pockets. The maximum dimension of any individual gas pocket shall not exceed 1/8 inch.

(e) Cracks. No weld containing cracks, regardless of size or location, shall be acceptable until such welds have been repaired in conformance with this specification.

(f) Accumulation of Discontinuities. Any accumulation of discontinuities having a total length of more than 2 inches in a weld length of 12 inches is unacceptable. Any accumulation of discontinuities which total more than 10 per cent of the weld length of a joint is unacceptable.

(g) Undercutting. Undercutting adjacent to the cover bead on the outside of the pipe shall not exceed 1/32-inch in depth and 2 inches in length. Undercutting adjacent to the root bead on the inside of the pipe shall not exceed 2 inches in length.

(2) Repair of Unacceptable Welds. At the option and under the supervision of the Company representative, repair of welds may be made by chipping, grinding, or flame gouging to clean metal, and rewelding. Such repaired areas shall be re-radiographed. No further repairs shall be allowed in repaired areas. Welds containing cracks may be repaired as stated in SPECIFICATIONS. Surface undercuts and pinholes may be repaired without chipping or grinding.

(3) Weldor Qualification by Radiography. Radiographic inspection shall not be used for the purpose of locating sound areas or areas containing discontinuities and thereafter making destructive tests of such areas to qualify or disqualify a weldor.

EXHIBIT "E"

SERVICE PIPE LINE COMPANY
WELDING PROCEDURE

APPLICABLE TO PIPE CONFORMING TO A.P.I. SPECIFICATIONS
5L GRADE - "B" AND 5LX GRADE - "X42"-"X46" & "X52"

PROCESS: Manual shielded metalic arc welding method for making girth welds on steel pipe.

BEVEL DESIGN: Machine beveled to 30° + 5° - 0° with 1/16 inch land. (Torch cut bevels will be acceptable provided the surface of the cut is smooth and the dimensions conform to those of machine cut bevels.)

BEVEL PREPARATION: Foreign matter shall be removed with power driven wire buffing wheels, sanding machines, or by hand filing. Oil, grease, etc. shall be removed with a solvent that will leave the surface clean.

SPACING: Approximately 1/16 inch of space shall be provided between the abutting pipe ends. Wedged shaped tools shall be used to obtain the required space. The pipe shall not be moved until more than 50% of the root bead has been deposited.

POSITION: Pipe axis shall be in horizontal fixed position supported by skids or suitable fixtures.

TYPE LINE-UP CLAMP: Internal expanding type clamps shall be used for pipe diameters 10 3/4-inches O.D. and above. External type clamps shall be used only where it is not possible to use internal clamps. External clamps may be used for pipe diameters up to 10 3/4-inches O.D.

DIRECTION OF WELDING: Weld beads shall be started near the top center of the pipe and stopped near the bottom center (no two weld beads shall be started or finished at the same point).

CLEANING WELD BEADS: All slag and foreign matter shall be removed from each bead of weld metal before additional weld metal is applied. Finish bead shall be cleaned for inspection.

The root and second welding beads shall be cleaned with power driven wire buffing wheels or hand cleaned with suitable tools.

REMOVAL OF LINE-UP CLAMP: Pressure applied with the line-up clamp to hold the abutting pipe ends in alignment for welding shall not be released until at least 50% of the root bead has been deposited.

TO APPLY ONLY TO
GRADE "B" AND GRADE "X42"
PIPE

PIPE MATERIAL: Pipe manufactured in accordance with A.P.I. Specification 5L, Grade B, and 5LX Grade X42 ranging in diameter from 3 1/2-inches O.D. through 24-inches O.D. with wall thickness .188 inches through .500 inches.

NUMBER OF WELDORS: That may work simultaneously on a weld.

	3 1/2" O.D. thru 6 5/8" O.D.	8 5/8" O.D. thru 18" O.D.	20" O.D. thru 24" O.D.
Root Bead	1 or 2	2 or 3	2 or 3
2nd Bead	1 or 2	2	2
Remaining Beads	1	1 or 2	1 or 2

FILLER METAL:

Bead	Electrode Size	Class Electrode
Root	1/8" or 5/32"	Fleetweld #5
2nd	5/32"	Fleetweld #5 or #85
Other	5/32" or 3/16"	Fleetweld #5 or #85

PREHEATING: When atmospheric temperature is below 15° F. pipe ends shall be preheated to a minimum of 300° F., prior to placing in alignment for welding. Preheat temperature to be determined with Tempilstiks.

TIME LAPSE BETWEEN BEADS: When preheating is required the 2nd bead shall be deposited within 3 minutes after completion of the root bead.

When welding pipe size 10 3/4-inches O.D. and above and preheating is not utilized the second bead shall be deposited within 10 minutes after completion of the root bead.

TO APPLY ONLY TO
GRADE "X46" AND GRADE "X52"
PIPE

PIPE MATERIAL: Pipe manufactured in accordance with A.P.I. Specification 5LX Grade X46 and Grade X52 ranging in diameter from 10 3/4-inches O.D. through 24-inches O.D. with wall thickness .250 through .500 inches.

NUMBER OF WELDORS: That may work simultaneously on a weld.

	10 3/4" O.D. thru 18" O.D.	20" O.D. thru 24" O.D.
Root Bead	2 or 3	3
2nd Bead	2	2
Remaining Beads	1 or 2	1 or 2

FILLER METAL:

Bead	Electrode Size	Class Electrode
Root	5/32"	Fleetweld #5
2nd	5/32"	Fleetweld #85
Other	3/16"	Fleetweld #85

PREHEATING: When the atmospheric temperature is below 50° F., the pipe ends shall be preheated to a minimum temperature of 300° F. prior to placing in alignment for welding. Preheat temperature to be determined by Tempilstiks.

TIME LAPSE BETWEEN BEADS:

Root and second bead - 3 minutes maximum.
Second and remaining beads - 15 minutes maximum.

After the second bead has been deposited, when preheating is being utilized, the remaining beads shall be deposited before the weld area has cooled to a temperature below 50° F.

Filler and finish beads shall be deposited without pause except for changing electrodes and cleaning between completion of one bead and the start of the next bead until all welding is finished.